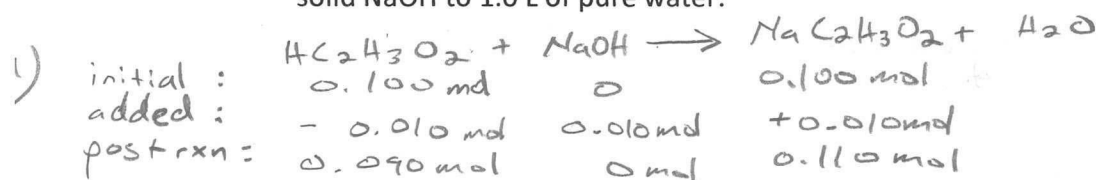


$$\frac{0.010 \text{ mol NaOH}}{1 \text{ L solution}} = [0.010 \text{ NaOH}]$$

Chapter 17 $pOH = -\log(0.010) = 2$

$$pH = 14 - 2 = 12$$

1. A 1.0-L buffer solution contains 0.100 mol acetic acid and 0.100 mol sodium acetate. The value of K_a for acetic acid is 1.8×10^{-5} . Calculate the new pH after adding 0.010 mol of solid NaOH to the buffer. For comparison, calculate the pH after adding 0.010 mol of solid NaOH to 1.0 L of pure water.



2) plug into H-H:

$$pH = pK_a + \log \frac{[C_2H_3O_2^-]}{[HC_2H_3O_2]} = 4.74 + \log \frac{(0.110)}{(0.090)} = 4.83$$

2. A 500.0-mL buffer solution is 0.100 M in HNO_2 and 0.150 M in KNO_2 . Determine if each addition would exceed the capacity of the buffer to neutralize it.

a. 2.50 g NaOH

$$2.50 \text{ g} \left(\frac{1 \text{ mol NaOH}}{40 \text{ g}} \right) \left(\frac{1 \text{ mol OH}^-}{1 \text{ mol NaOH}} \right) = 0.0625 \text{ mol OH}^-$$

mol $OH^- >$ mol HNO_2 so buffer won't work.

b. 1.25 g HBr

$$1.25 \text{ g HBr} \left(\frac{1 \text{ mol HBr}}{80.9 \text{ g}} \right) \left(\frac{1 \text{ mol H}^+}{1 \text{ mol HBr}} \right) = 0.015 \text{ mol H}^+$$

mol $H^+ <$ mol NO_2^- so buffer works

c. 3.60 g KOH

$$3.60 \text{ g KOH} \left(\frac{1 \text{ mol KOH}}{56.1 \text{ g}} \right) \left(\frac{1 \text{ mol OH}^-}{1 \text{ mol KOH}} \right) = 0.064 \text{ mol OH}^-$$

mol $OH^- >$ mol HNO_2 , buffer won't work

d. 1.35 g HI

$$1.35 \text{ g HI} \left(\frac{1 \text{ mol HI}}{127.9 \text{ g}} \right) \left(\frac{1 \text{ mol H}^+}{1 \text{ mol HI}} \right) = 0.011 \text{ mol H}^+ \rightarrow \text{mol H}^+ < \text{mol NO}_2^-, \text{ buffer works}$$

→ exceed buffer capacity if add acid/base beyond the amount the buffer can neutralize. In this buffer, there are

$$0.500 \text{ L} \times \frac{0.100 \text{ mol } HNO_2}{\text{L}} = 0.050 \text{ mol acid}$$

$$0.500 \text{ L} \times \frac{0.150 \text{ mol } KNO_2}{\text{L}} = 0.075 \text{ mol base}$$

3. A chemist has synthesized a monoprotic weak acid and wants to determine its K_a value.

To do so, the chemist dissolves 2.00 millimoles of the solid acid in 100.0 mL of water and titrates the resulting solution with 0.0500 M NaOH. After 20.0 mL NaOH has been added, the pH is 6.00. What is the K_a value for the acid?



initial:	0.002 mol	0	0
added:	- 0.001 mol	0.001 mol	+ 0.001 mol
post rxn:	0.001 mol	0	0.001 mol

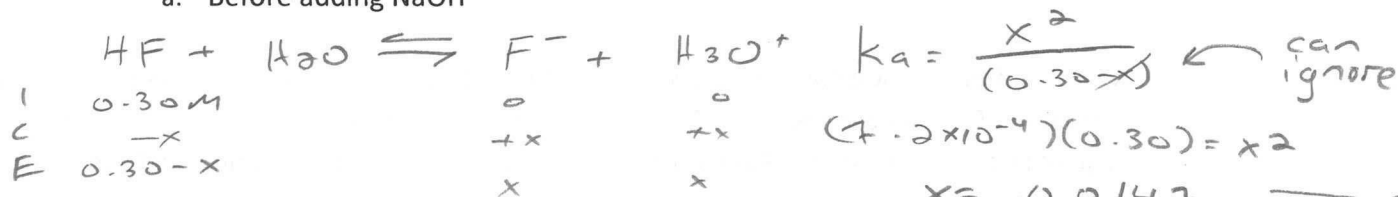
$$pH = pK_a + \log \left(\frac{A^-}{HA} \right)$$

$$6.00 = pK_a + \log \left(\frac{0.001}{0.001} \right)$$

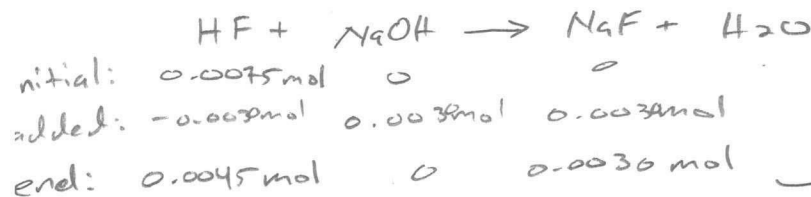
$$pK_a = 6.00 \quad | \quad K_a = 10^{-6}$$

4. Find the pH at each of the following points in the titration of 25 mL of 0.30 M HF with 0.30 M NaOH. The K_a HF = 7.2×10^{-4}

a. Before adding NaOH



b. After adding 10.00 mL of NaOH



in a buffer, use HH:

$$\text{pH} = \text{p}K_a + \log\left(\frac{B}{A}\right)$$

$$\text{pH} = 3.14 + \log\left(\frac{0.0030}{0.0045}\right) = \boxed{2.97}$$

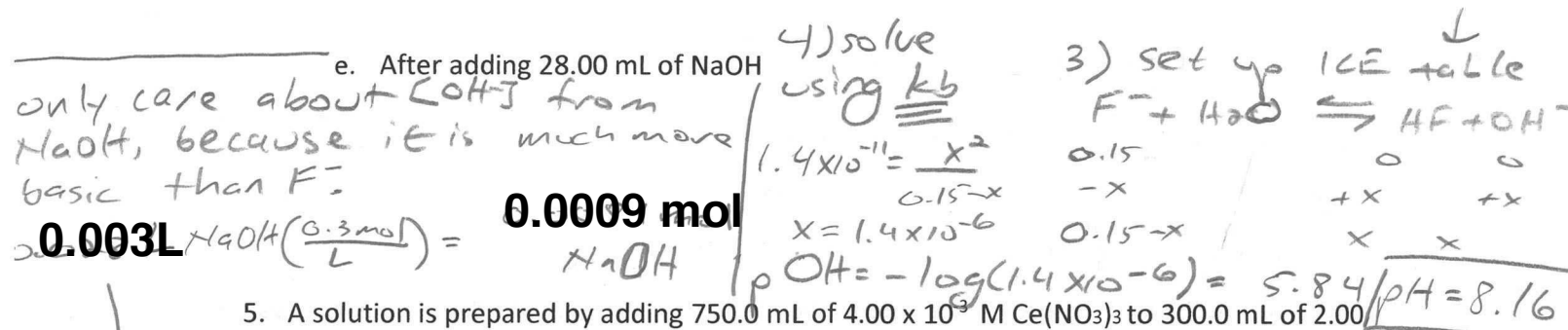
c. At $\frac{1}{2}$ equivalence point

$$\text{pH} = \text{p}K_a$$

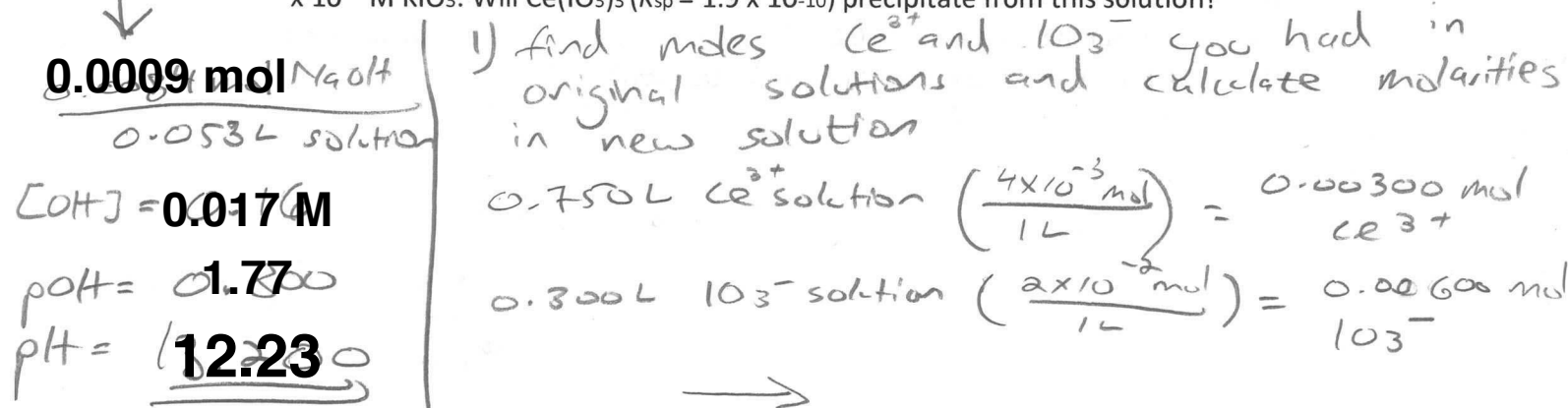
$$\boxed{\text{pH} = 3.14}$$

d. At the equivalence point

1) to titrate 0.0075 mol HF, need 0.0075 mol NaOH; if [NaOH] was 0.300 M, then added 25 mL of NaOH.
2) so created 0.0075 mol F^- in 0.050 L soln $\rightarrow [\text{F}^-] = \frac{0.0075}{0.050} = 0.15 \text{ M}$



5. A solution is prepared by adding 750.0 mL of $4.00 \times 10^{-3} \text{ M}$ $\text{Ce}(\text{NO}_3)_3$ to 300.0 mL of $2.00 \times 10^{-2} \text{ M}$ KIO_3 . Will $\text{Ce}(\text{IO}_3)_3$ ($K_{sp} = 1.9 \times 10^{-10}$) precipitate from this solution?



2) new concentrations

$$\frac{0.00300 \text{ mol } \text{Ce}^{3+}}{(0.750 \text{ L} + 0.300 \text{ L})} = 0.00286 \text{ M } \text{Ce}^{3+}$$

$$\frac{0.00600 \text{ mol } \text{IO}_3^-}{(0.750 \text{ L} + 0.300 \text{ L})} = 0.00571 \text{ M } \text{IO}_3^-$$

3) now its a Q_{sp} vs. K_{sp} problem



$$Q = [\text{Ce}^{3+}] \times [\text{IO}_3^-]^3$$

$$Q = (0.00286)(0.00571)^3 = 5.33 \times 10^{-10}$$

$$Q_{sp} > K_{sp}$$

$5.33 \times 10^{-10} > 1.9 \times 10^{-10}$, means we have too many products, so rxn shifts to left and $\text{Ce}(\text{IO}_3)_3$ precipitates out.